10/619512

PTO 05-3043

CY=DE DATE=19770908 KIND=A1
PN=2 612 424

VAPOR DEPOSITION SOURCE
[Aufdampfquelle]

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UNITED STATES PATENT AND TRADEMARK OFFICE
Washington, D.C. April 2005

Translated by: FLS, Inc.

PUBLICATION COUNTRY	(10):	DE
DOCUMENT NUMBER	(11):	2612424
DOCUMENT KIND	(12):	A1
	(13):	Applications
PUBLICATION DATE	(43):	19770908
PUBLICATION DATE	(45):	
APPLICATION NUMBER	(21):	P2612424.3
APPLICATION DATE	(22):	19760324
ADDITION TO	(61):	
INTERNATIONAL CLASSIFICATION	(51):	C23C 15/00
DOMESTIC CLASSIFICATION	(52):	
PRIORITY COUNTRY	(33):	CH
PRIORITY NUMBER	(31):	2617-76
PRIORITY DATE	(32):	19760303
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TITLE	(54):	VAPOR DEPOSITION SOURCE
FOREIGN TITLE	[54A]:	Aufdampfquelle

Claims

/1[*]

1. Point-like, alignable, and spatter-free vapor-deposition source for evaporant in high-vacuum vapor-deposition devices, having a trough-shaped evaporator boat heated by direct passage of current through it, characterized in that trough-shaped evaporator boat (1) is closed off by a labyrinth-like covering arranged over the material that is to be evaporated, at least on the wall side.

2. A vapor-deposition source as recited in Claim 1, characterized in that the labyrinth-like covering comprises a cover provided with a central opening (3) and an intermediate piece (2) placed at a distance from cover (3), provided with passages at at least two edge zones.

3. A vapor-deposition source as recited in Claim 2, characterized in that the opening in cover (3) has a circular shape.

4. A vapor-deposition source as recited in Claim 2, characterized in that the opening in cover (3) has a shape extending parallel to the contours of the outer walls of the evaporator boat.

5. A vapor-deposition source as recited in Claim 2, characterized in that the opening in cover (3) has an elliptical or rectangular shape. /2

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[*] Numbers in the margin indicate pagination in the foreign text.

Vapor-deposition source /3

This invention relates to a point-like, alignable, and spatter-free vapor-deposition source for evaporant in high-vacuum vapor-deposition devices, having a trough-shaped evaporator boat that is heated by passing current directly through it.

As we know, thin layers are produced mostly by the vapor deposition of materials under a high vacuum. Vapor-deposition sources include, for example, metal wires or metal bands that are heated by passing current directly through them and that sublimate from the solid aggregate state. Radiation plates are used to keep the heat consumption to a minimum and often to direct the vapor jet.

Evaporant, which is already liquid at the required vaporization /4 temperature, must be heated by external heating. A number of arrangements and heating devices have been developed for this purpose. Thus, heating elements in the form of wires or bands have been used for wetting evaporants. For example, bent aluminum wires or bands were hung on an undulating piece of tungsten wire. A current flowing through the piece of tungsten wire heated the tungsten wire piece and caused the aluminum to melt, then evaporate.

Evaporator boats are known, for example, that are made of tungsten or molybdenum, which are also heated by passing a current directly through them, heating the evaporant in them which for the most part sublimates.

Also known are crucible-like vapor-deposition sources of quartz or ceramic, as well as crucibles of graphite and the like for evaporants with high vaporization temperatures.

An overview of the most important vapor-deposition sources is presented by M. Auwärter, Ergebnisse der Hochvakuumtechnik und der Physik dünner Schichten [Results of High-Vacuum Techniques and the Physics of Thin Layers], 1957, p. 69.

The known vapor-deposition sources all have the disadvantage /5 that they tend to spatter and either they are not alignable or permit alignment of the vapor jets only with radiation plates and the like. Another frequent disadvantage is the relatively large-surfaced vapor-deposition source, which makes a definite slantwise deposition impossible.

The object of the present invention is to create a vapor-deposition source that does not have the above-mentioned disadvantages, in particular it is alignable, produces no spattering even during heating, and vaporized from a definite point.

The invention is characterized in that the trough-shaped evaporator boat is closed off, at least on the wall side, by a labyrinth-like covering arranged over the material that is to be evaporated.

A wall-side labyrinth-like covering is taken to be a covering that closes off the side walls of the evaporator boat in such a way

that, after redirection in the labyrinth, a vapor jet can emerge only in the central region of the vapor-deposition source.

An exemplary embodiment of the invention will be presented with the help of drawings.

The figures show: /6

Figure 1: a vapor-deposition device having a vapor-deposition source in accordance with this invention, and

Figure 2: details of the vapor-deposition source of Fig. 1.

The vapor-deposition device in Fig. 1 has a centrally arranged vapor-deposition source, consisting of an evaporator boat **1**, an intermediate piece **2**, and a cover **3**. This vapor-deposition source is clamped between two electrodes **4**. Electrodes **4** are connected via electrode connections **5** to a current source **6**. The vapor-deposition source and the electrode connections **5** are located inside a vacuum chamber **8**, provided with a vacuum pump **7**. Inside vacuum chamber **8** there are also a substrate holder **9** with a substrate **10** that is to be coated and a cover plate **11**, which covers the bottom of vacuum chamber **8**.

In vacuum chamber **8**, which is evacuated in a conventional manner, the evaporant located in evaporator boat **2** is heated by a current flowing through the vapor-deposition source. Once the vaporization temperature of the evaporant has been reached, a conical vapor jet is formed. The opening angle of this vapor jets is indicated by the symbol γ.

Figure 2 shows details of the vapor-deposition source.

Evaporator boat **1** is made of tungsten and is connected in a positively locking manner with intermediate piece **2** and cover **3**. In its edge zones, intermediate piece **2** has circular passages **2a**. In the center of cover **3** there is a circular opening **3a** and at least one guide bracket **3b** on its long side. /7

The evaporant is placed in evaporator boat **1**. The angled part of intermediate piece **2** extends approximately halfway into the trough-shaped part of evaporator boat **1** and closes the latter completely off on the wall sides. It has been found that the new vapor-deposition source can be used instead of the previously known, commercially available evaporator boats with no problems. With a pressure of $3 \cdot 10^{-5}$ torr in vacuum chamber **8**, silicon monoxide was deposited on a substrate **10** located approximately 30 cm form the vapor-deposition source at a deposition rate of 110 Å/s. While this deposition rate was achieved with a commercially available boat at a voltage of 2.5 V and a current of 5.5 A, these values changed to a voltage of ca. 2 V and a current of 6.25 A, due to the low resistance of the novel vapor-deposition source. Unlike with the conventional evaporator boat, the novel source could be heated without covering, i.e., without an additional aperture. The deposited layer on substrate **10** was completely spatter-free. /8

A similar experiment was carried out with tungsten trioxide. A deposition rate of ca. 100 Å/s was achieved at a pressure of $6 \cdot 10^{-5}$ torr. Once again, the voltage was approximately 10% lower when the novel vapor-deposition source was used, while the current was 5.9 A. In this experiment, absolutely no spattering could be found on the surface of substrate **10** when the novel vapor-deposition source was used, while with the conventional evaporator boat spattering could be seen with the naked eye. The distance between source and substrate was once again 30 cm in both cases.

Possible materials for the novel vapor-deposition sources include W, Mo, Ta, Nd, Fe, Ni, and Ni-Cr. These are metals that have proven reliable for evaporator boats.

With proper dimensioning and shaping of opening **3a** in cover **3** and by a suitable choice of distance between intermediate piece **2** and the evaporant, the vapor jet can by and large be determined in advance. It should be noted that opening **3a** does not overlap passages **2a** and that the vapor-deposition source is positioned such that spattering evaporant cannot directly reach substrate **10** that is being coated.

The novel vapor-deposition sources could also be made by /9
converting a conventional evaporator boat, adding a labyrinth-like covering in accordance with this invention. Evaporator boats of the 490 111 series from Balzers seem to be suitable for this purpose.

28/76 2/1
2 Blätter - Nr. 1

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2612424

Nummer: 26 12 424
Int. Cl.2: C 23 C 15/00
Anmeldetag: 24. März 1976
Offenlegungstag: 8. September 1977

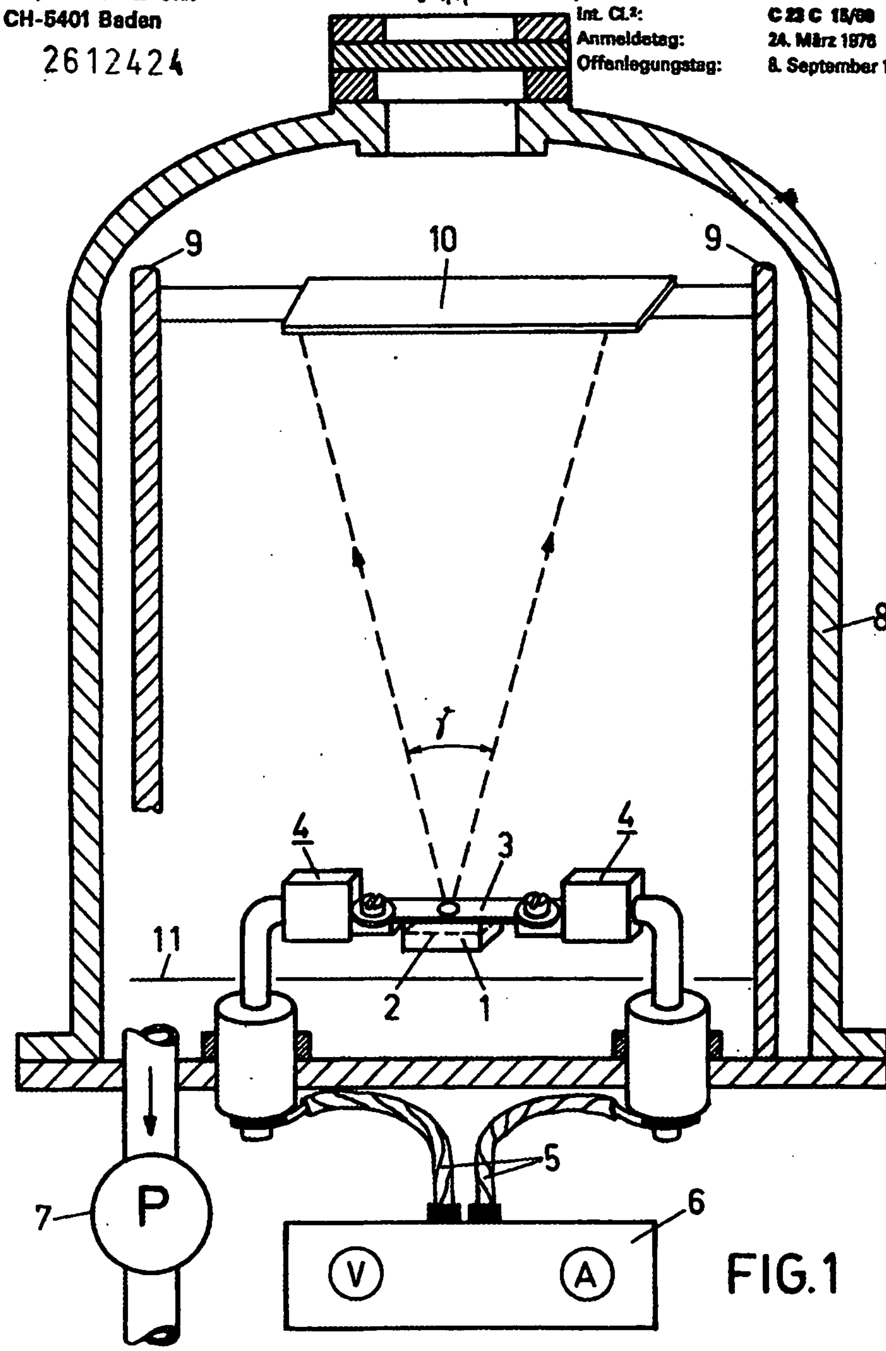

FIG.1

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2 Blätter - Nr. 2

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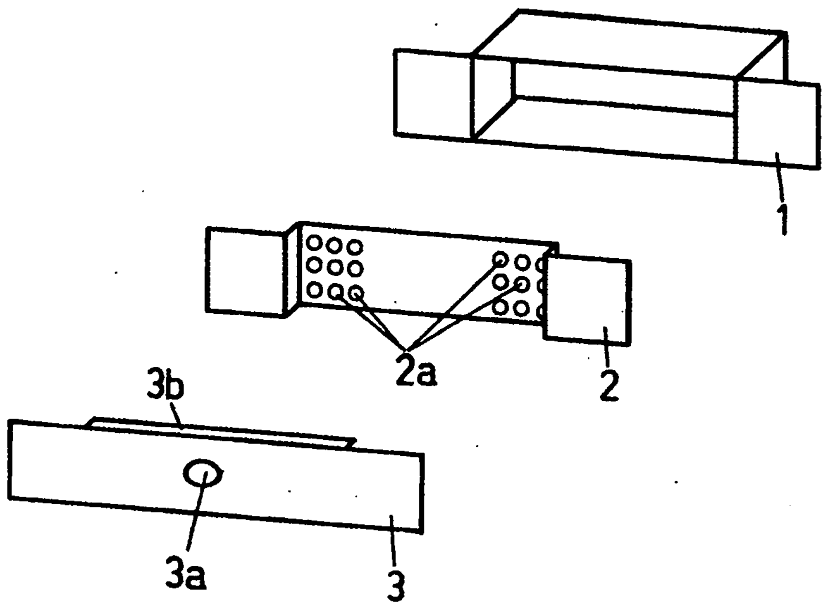

FIG. 2

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